Top Tips in Interventional Oncology

Clinical and technical insights into treating hepatocellular carcinoma, cholangiocarcinoma, renal cell carcinoma, lung cancer, bone cancer, and in the palliative care setting.

Hepatocellular Carcinoma

BY SIDDHARTH A. PADIA, MD

TIP 1

Diagnosis of hepatocellular carcinoma (HCC) is often based on imaging per American Association for the Study of Liver Diseases guidelines.[1] When imaging criteria satisfy a diagnosis of HCC, biopsy is not needed. However, consider a biopsy in patients without underlying cirrhosis or to exclude metastases from an extrahepatic primary site.

TIP 2

Liver transplantation is the only curative treatment for HCC and cirrhosis. Although most institutions adhere to Milan criteria for inclusion of HCC patients, many regions have recently adopted broader policies to allow downstaging to tumors. One should be familiar with the institution's eligibility criteria.

TIP 3

An outpatient consultation with the patient facilitates the discussion of all treatment options. It also allows the physician to assess the degree of clinical sequelae from cirrhosis and performance status. Patient performance status is a key prognosticator for survival, regardless of the chosen therapy.

TIP 4

Multiple staging systems for HCC and cirrhosis are used. The Barcelona Clinic Liver Cancer staging system is the most widely accepted in Westernized countries and has been shown to appropriately stratify patients based on overall survival.[2] The Hong Kong staging system has often been utilized in the Asian HCC population, where hepatitis B is often the causative factor.[3] Despite the multiple staging systems used for HCC, treatment decisions are loosely based on these algorithms.

TIP 5

Underlying cirrhosis is usually present with HCC. Therefore, one must manage two disease states, which differs from oncologic management in other malignancies. Consider locoregional therapy in patients with Child-Pugh A or early Child-Pugh B cirrhosis. Although caution is warranted in patients with advanced cirrhosis (eg, ≥ Child-Pugh B8), treatment can be considered if they are focal, where the majority of the hepatic parenchyma are spared. Recently, the ALBI (albumin-bilirubin index) score has also shown promise as a liver function scoring system.[4]

TIP 6

Early stage HCC (within Milan criteria) has multiple treatment options, including surgical resection, thermal ablation (Figure 1), segmental transarterial chemoembolization (TACE), and segmental yttrium-90 (Y-90) radioembolization (Figure 2). One should be familiar with tumor response rates, recurrence rates, and complications for each therapy. Choice of therapy is often physician and institution dependent, relying on local experience and expertise.

Figure 1. A 58-year-old man with Child-Pugh A cirrhosis, portal hypertension, and a single 2.5-cm HCC in the right hepatic lobe. Given his lack of comorbidities and a straightforward technical approach, an image-guided percutaneous thermal ablation was performed.

TIP 7

Intermediate-stage HCC (ie, multifocal HCC) is typically treated with a transarterial therapy, either chemoembolization or radioembolization. Both therapies have shown similar survival in this category, with superior time to progression with Y-90 radioembolization compared with chemoembolization.[5] Consider age, performance status, and degree of cirrhosis when choosing the appropriate therapy.

TIP 8

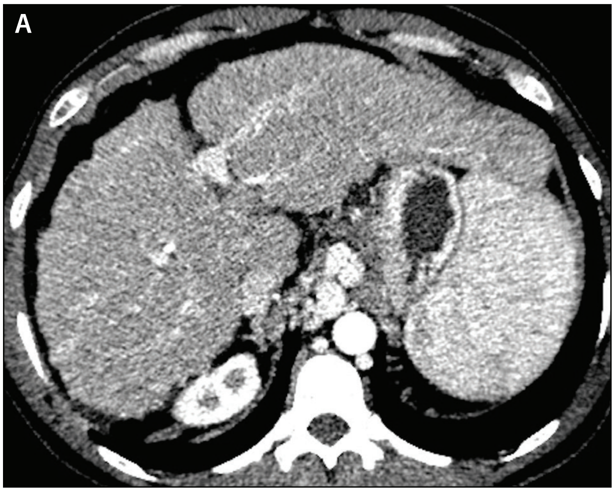
Advanced-stage HCC (ie, portal venous tumor invasion) portends a guarded prognosis for patients. Despite most guidelines recommending systemic therapy, the survival benefit of systemic therapy is modest. Patients undergoing transarterial therapy, particularly radioembolization, have shown very promising response and survival in nonrandomized studies. When treating patients with advanced HCC, an optimized technique results in superior outcomes and includes individualized dosing, segmental infusions, and staged treatments. Consider combining locoregional therapy with systemic therapy.

TIP 9

Follow-up of HCC patients after locoregional therapy should be done by the treating physician, who can most appropriately interpret cross-sectional imaging in the context of the treatment rendered and the patient's treatment goals. Imaging is typically performed 1 month after treatment and then every 2 to 3 months thereafter.

TIP 10

Multidisciplinary management of the patient with HCC is paramount to successful outcomes. Although the interventional radiologist plays a vital role in treating most stages of HCC, many tumors may not be amenable to treatment. When necessary, stereotactic



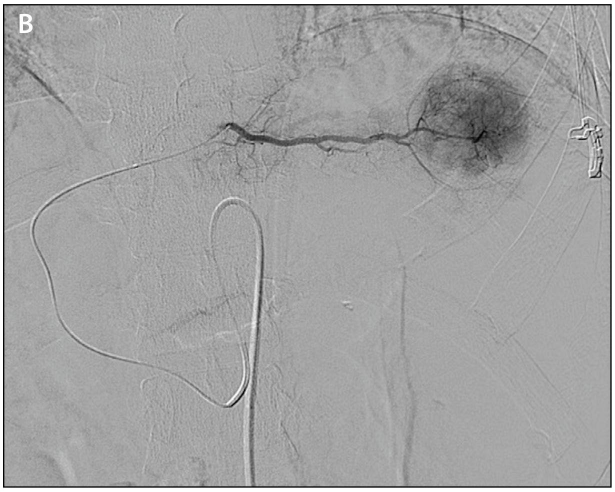


Figure 2. A 32-year-old patient with primary biliary cirrhosis (Child-Pugh B) and portal hypertension presented with a 2-cm HCC in the periphery of segment II (A). Given its proximity to the lung and colon, segmental Y-90 radioembolization was performed (B).

body radiation therapy may treat tumors in locations that are difficult to treat with ablation or embolization. Access to clinical trials and palliative care for the advanced-stage HCC patient is appropriate and can be achieved with multidisciplinary discussion.

1. Marrero JA, Kulik LM, Sirlin CB, et al. Diagnosis, staging, and management of hepatocellular carcinoma: 2018 practice guidance by the American Association for the Study of Liver Diseases. Hepatology. 2018;68:723-750.
2. Forner A, Llovet JM, Bruix J. Hepatocellular carcinoma. Lancet. 2012;379:1245-1255.
3. Yau T, Tang VY, Yao TJ, et al. Development of Hong Kong Liver Cancer staging system with treatment stratification for patients with hepatocellular carcinoma. Gastroenterology. 2014;146:1691-1700.e3.
4. Johnson PJ, Berhane S, Kagebayashi C, et al. Assessment of liver function in patients with hepatocellular carcinoma: a new evidence-based approach-the ALBI grade. J Clin Oncol. 2015;33:550-558.
5. Salem R, Gordon AC, Mouli S, et al. Y90 radioembolization significantly prolongs time to progression compared with chemoembolization in patients with hepatocellular carcinoma. Gastroenterology. 2016;151:1155-1163.e2.

Siddharth A. Padia, MD
Section of Interventional Radiology
Department of Radiology
David Geffen School of Medicine
University of California Los Angeles
Los Angeles, California
spadia@mednet.ucla.edu
Disclosures: Consultant to BTG International, Bristol-Meyers Squibb, AngioDynamics, and ICON Research; receives research funding from Boston Scientific Corporation.

Cholangiocarcinoma

BY THEODORE BRYAN, MD; REBECCA BENNETT, MD; AND NADINE ABI-JAOUDEH, MD, FSIR, CCRP

The age-adjusted incidence rate of intrahepatic cholangiocarcinoma (iCCA) has increased in both Europe and the United States over the last several decades.[1] iCCA is incidentally detected in 19% to 43% of cases, and only 25% of symptomatic patients versus 58% of asymptomatic patients have resectable disease at the time of diagnosis.[2] This leaves a large portion of the patient population eligible only for palliative systemic chemotherapy or locoregional therapies. The combination of gemcitabine and cisplatin is the current standard chemotherapeutic regimen, with a median overall survival of 12 months.[3] External beam radiation therapy is not currently recommended.[4]

TIP 1

The initial workup for suspected iCCA should include a quadruple-phase CT or MRI to determine operability. Carcinoembryonic antigen, carbohydrate antigen 19-9, and alpha fetoprotein levels should also be obtained.[4]

TIP 2

Multifocal intrahepatic disease, vascular invasion, and extrahepatic disease are considered contraindications to surgical resection. MELD (Model for End-stage Liver Disease) scores ≥ 9 may be considered a relative contraindication.[5]

TIP 3

If available, volumetric MRI may be advantageous for patients who will ultimately undergo locoregional therapy. Lower apparent diffusion coefficient values and higher percentages of viable tumor at baseline were shown to help predict mortality risk in patients with iCCA who underwent TACE.[6]

TIP 4

In cirrhotic patients, it is especially important to distinguish whether the mass has features more typical of hepatocellular carcinoma, and biopsy should be performed if there is any ambiguity. Pathologic diagnosis is necessary for the diagnosis of iCCA according to World Health Organization criteria, and immunohistochemical markers can be helpful.

TIP 5

Currently, there is no established first-line locoregional therapy for unresectable iCCA. Data suggest that combined drug-eluting embolic TACE and systemic chemotherapy prolongs overall survival over chemotherapy alone (30 vs 12.7 months).[7] Conventional TACE and transarterial radioembolization have both demonstrated prolonged survival,[8-10] but further randomized controlled trials are necessary.

TIP 6

Radiofrequency (RF) ablation may be used for solitary intrahepatic lesions < 3 cm when surgery is not an option or in cases of local recurrence/residual tumor after surgery.[11] The majority of the data pertains to RF ablation, but other heat-based modalities are reasonable alternatives.[12]

TIP 7

RF ablation is also emerging as a palliative therapy in cases of perihilar cholangiocarcinoma. Recent studies have demonstrated that intraductal RF ablation combined with metal stent placement improves the duration of stent patency.[13] Irreversible electroporation (NanoKnife, AngioDynamics) is also currently being studied for use in the treatment of perihilar cholangiocarcinoma.

1. Tyson GL, Ilyas JA, Duan Z, et al. Secular trends in the incidence of cholangiocarcinoma in the USA and the impact of misclassification. Dig Dis Sci. 2014;59:3103-3110.
2. Endo I, Gonen M, Yopp AC, et al. Intrahepatic cholangiocarcinoma: rising frequency, improved survival, and determinants of outcome after resection. Ann Surg. 2008;248:84-96.
3. Valle J, Harpreet Wasan, Daniel H. Palmer, et al. Cisplatin plus gemcitabine versus gemcitabine for biliary tract cancer. N Engl J Med. 2010;362:1273-1281.
4. Bridgewater J, Galle PR, Khan SA, et al. Guidelines for the diagnosis and management of intrahepatic cholangiocarcinoma. J Hepatol. 2014;60:1268-1289.
5. Li YY, Li H, Lv P, et al. Prognostic value of cirrhosis for intrahepatic cholangiocarcinoma after surgical treatment. J Gastrointest Surg. 2011;15:608-613.
6. Pandey A, Pandey P, Ghasabeh MA, et al. Baseline volumetric multiparametric MRI: can it be used to predict survival in patients with unresectable intrahepatic cholangiocarcinoma undergoing transcatheter arterial chemoembolization? Radiology. 2018;289:843-853.
7. Poggi G, Amatu A, Montagna B, et al. OEM-TACE: a new therapeutic approach in unresectable intrahepatic cholangiocarcinoma. Cardiovasc Interv Radiol. 2009;32:1187-1192.
8. Park SY, Kim JH, Yoon HJ, et al. Transarterial chemoembolization versus supportive therapy in the palliative treatment of unresectable intrahepatic cholangiocarcinoma. Clin Radiol. 2011;66:322-328.
9. Abeysinghe V, Sundararajan S, Delriviere L, Tibballs J. Selective internal radiation therapy (SIRT) with yttrium-90 microspheres for unresectable intrahepatic cholangiocarcinoma. BMJ Case Rep. 2018;2018:pii: bcr-2017-223539.
10. Ibrahim SM, Mulcahy MF, Lewandowski RJ, et al. Treatment of unresectable cholangiocarcinoma using yttrium-90 microspheres. Cancer. 2008;113:2119-2128.
11. Kim JH, Won HJ, Shin YM, et al. Radiofrequency ablation for the treatment of primary intrahepatic cholangiocarcinoma. Am J Roentgenol. 2011;196:W205-W209.
12. Livraghi T, Meloni F, Solbiati L, Zanus G. Complications of microwave ablation for liver tumors: results of a multicenter study. Cardiovasc Interv Radiol. 2011;35:868-874.
13. Cui W, Wang Y, Fan W, et al. Comparison of intraluminal radiofrequency ablation and stents vs. stents alone in the management of malignant biliary obstruction. Int J Hyperthermia. 2017;4:1-9.

Theodore Bryan, MD
Resident, Department of Radiological Sciences
University of California, Irvine
Orange, California
Disclosures: None.

Rebecca Bennett, MD
Resident, Department of Radiological Sciences
University of California, Irvine
Orange, California
Disclosures: None.

Nadine Abi-Jaoudeh, MD, FSIR, CCRP
Associate Professor of Radiological Sciences
Director, Research of Interventional Radiology
UC Irvine Medical Center
Orange, California
nadine@uci.edu
Disclosures: Sponsored research, Sillajen Inc. and Sirtex, Inc.; research collaboration with UC Irvine, Philips Medical Systems Inc. and Teclison Cheery Pharma; shareholder in Bruin Biosciences Inc.

Renal Cell Carcinoma

BY RAUL N. UPPOT, MD

Twenty years have passed since the first image-guided renal tumor ablation.[1] Based on long-term and meta-analysis studies,[2-4] the American Urological Association (AUA) revised its renal mass and localized renal cancer guidelines in 2017 to state, "Consider TA [thermal ablation] as an alternate approach [to radical and partial nephrectomy] for the management of cT1a renal masses < 3 cm in size."[5]

Tools and techniques to perform ablations have evolved to become safer and more efficient.

TIP 1

Always perform a biopsy prior to ablation, as recommended by the AUA.[5,6]

TIP 2

The literature confirms that there is no need for antibiotics.[7] Thus, we only prescribe antibiotics if placing a retrograde stent.

TIP 3

Preablation embolization of large renal tumors can improve outcomes[8-10] and decrease the number of cryoprobes.[11]

TIP 4

Beware of lower pole tumors and their proximity to the ureter. Pyeloperfusion is a useful tool to protect the ureter.[12]

TIP 5

For cryoablation, ensure that the ice ball margin extends at least 1 cm beyond the margin of the tumor, if technically possible (Figure 1). The 1 cm allows the "kill zone," defined as 5 mm inside the visible ice ball, to extend 5 mm beyond margin of tumor. This means that a 1-cm visible ice ball, if safely possible, ensures complete tumor coverage.

TIP 6

Use of the "fast thaw" feature, which is available with some cryoablation devices, allows cauterization of the tract as the probe is being removed to minimize the risk of hemorrhage.

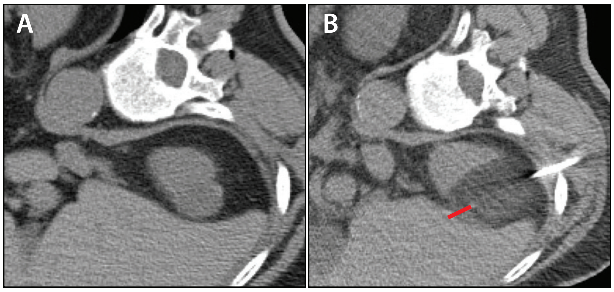


Figure 1. A 74-year-old man with a right renal tumor. Preliminary (A) and second freeze 10-minute cryoablation (B) CT images show the visible ice ball extending 1.2 cm (red line) beyond the anterior margin of tumor. This large volume of ice ball ensures adequate coverage.

TIP 7

Don't be afraid to treat T1b or oligometastatic disease. AUA recommendations focus on T1a tumors. With advances in ablation tools and techniques, there are increasing instances of using ablation to treat T1b tumors.[13]

TIP 8

Add microwave ablation as a tool to treat renal cell carcinoma. In properly selected patients, microwave ablation allows for faster ablation, resulting in decreased overall radiation dose and sedation. Literature exists supporting the use of microwave ablation as a tool to treat renal cell carcinoma.[14-17]

TIP 9

If using microwave ablation, do not puncture the collecting system. Place the antennae via a tangential approach (Figure 2). This will avoid calyceal leak and potential "boiling" of urine and possible ureteropelvic junction stricture.

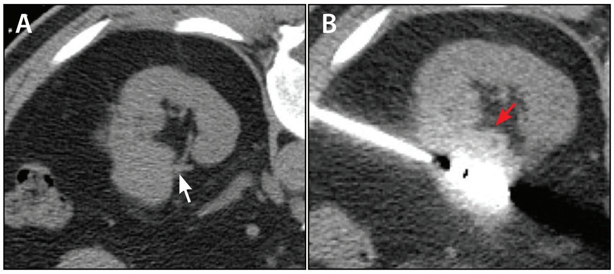


Figure 2. A 58-year-old man with renal cell carcinoma who had undergone cryoablation 2 years earlier and had a 2.5- X 2.1- X 2.5-cm recurrence along the anteromedial margin of the previous ablation zone (A). Due to proximity to branches of the left renal artery (white arrow), we performed microwave ablation. Note the tangential approach of the probe to the renal calyx (red arrow) (B).

TIP 10

Use ERAP (enhanced recovery after procedure) and nerve block.[18,19] For our ablations, we now administer a cocktail of anti-inflammatory medications and steroids to address any postprocedural inflammation and pain. Our anesthesia team administers a paravertebral block to decrease pain and therefore decrease the need for opioid use.

1. McGovern FJ, Wood BJ, Goldberg SN, Mueller PR. Radio frequency ablation of renal cell carcinoma via image guided needle electrodes. J Urol. 1999;161:599-600.
2. Gervais DA, McGovern FJ, Arellano RS, et al. Radiofrequency ablation of renal cell carcinoma: part 1, indications, results, and role in patient management over a 6-year period and ablation of 100 tumors. AJR Am J Roentgenol. 2005;185:64-71.
3. Best SL, Park SK, Youssef RF, et al. Long-term outcomes of renal tumor radio frequency ablation stratified by tumor diameter: size matters. J Urol. 2012;187:1183-1189.
4. Pierorazio PM, Johnson MH, Patel HD, et al. Management of renal masses and localized renal cancer: systematic review and meta-analysis. J Urol. 2016;196:989-999.
5. Campbell S, Uzzo RG, Allaf ME, et al. Renal mass and localized renal cancer: AUA guideline. J Urol. 2017;198:520-529.
6. Tsang Mui Chung MS, Maxwell AW, Wang LJ, et al. Should renal mass biopsy be performed prior to or concomitantly with thermal ablation? J Vasc Interv Radiol. 2018;29:1240-1244.
7. Crawford D, vanSonnenberg E, Kang P. Infectious outcomes from renal tumor ablation: prophylactic antibiotics or not? Cardiovasc Intervent Radiol. 2018;41:1573-1578.
8. Nakasone Y, Kawanaka K, Ikeda O, et al. Sequential combination treatment (arterial embolization and percutaneous radiofrequency ablation) of inoperable renal cell carcinoma: single-center pilot study. Acta Radiol. 2012;53:410-414.
9. Gunn AJ, Mullenbach BJ, Poundstone MM, et al. Trans-arterial embolization of renal cell carcinoma prior to percutaneous ablation: technical aspects, institutional experience, and brief review of the literature. Curr Urol Rep. 2018;12:43-49.
10. Yamakado K, Nakatsuka A, Kobayashi S, et al. Radiofrequency ablation combined with renal arterial embolization for the treatment of unresectable renal cell carcinoma larger than 3.5 cm: initial experience. Cardiovasc Intervent Radiol. 2006;29:389-394.
11. Harmon TS, Matteo J, Meyer TE, Kee-Sampson J. Pre-cryoablation embolization of renal tumors: decreasing probes and saving loads. Cureus. 2018;10:e3676.
12. Cantwell CP, Wah TM, Gervais DA, et al. Protecting the ureter during radiofrequency ablation of renal cell cancer: a pilot study of retrograde pyeloperfusion with cooled dextrose 5% in water. J Vasc Interv Radiol. 2008;19:1034-1040.
13. Atwell TD, Vlaminck JJ, Boorjian SA, et al. Percutaneous cryoablation of stage T1b renal cell carcinoma: technique considerations, safety, and local tumor control. J Vasc Interv Radiol. 2015;26:792-799.
14. Yu J, Liang P. Microwave ablation in renal cell carcinoma. In: Liang P, Yu XL, Yu J, eds. Microwave Ablation Treatment of Solid Tumors. Dordrecht, the Netherlands: Springer; 2015:183-193.
15. Cornelis FH, Marcelin C, Bernhard JC. Microwave ablation of renal tumors: a narrative review of technical considerations and clinical results. Diagn Interv Imaging. 2017;98:287-297.
16. Zhou W, Arellano RS. Thermal ablation of T1c renal cell carcinoma: a comparative assessment of technical performance, procedural outcome, and safety of microwave ablation, radiofrequency ablation, and cryoablation. J Vasc Interv Radiol. 2018;29:943-951.
17. Zhou W, Herwald SE, McCarthy C, et al. Radiofrequency ablation, cryoablation and microwave ablation for T1a renal cell carcinoma: a comparative evaluation of therapeutic and renal function outcomes. J Vasc Interv Radiol. 2019;30:1035-1042.
18. Dubut J, Kastler B, Delabrousse E, et al. CT-guided paravertebral block for microwave ablation of kidney tumors: a new technique. Abdom Radiol (NY). 2016;41:1197-1202.
19. Moawad HS, Taha DE. Paravertebral block against intercostal nerve block for postoperative pain relief in open renal surgery: a randomized controlled trial. Ain Shams J Anaesthesiol. 2015;8:413-419.

Raul N. Uppot, MD
Division of Interventional Radiology
Massachusetts General Hospital
Harvard Medical School
Boston, Massachusetts
uppot.raul@mgh.harvard.edu
Disclosures: None.

Lung Cancer

BY ROBERT SUH, MD

Image-guided thermal ablation (IGTA) for primary and secondary pulmonary malignancies has been successful at our institution for over 20 years. IGTA is inclusive of RF ablation, microwave ablation, and cryoablation and is a form of local therapy or local ablative therapy that generally can be considered as a potential alternative to other local therapies. The following tips provide insight into the best practices in lung ablation.

TIP 1

The initial size of the targeted tumor is the best predictor for local control by thermal ablation.

TIP 2

Mindful patient selection for both primary and secondary lung malignancies is essential, ideally within the setting of a multidisciplinary tumor board(s). Restage patients prior to ablation. Consider positron emission tomography (PET)/CT for PET-avid tumors.

TIP 3

Maintain active participation and presence at multidisciplinary care meetings focused on thoracic tumor treatments. Be engaged and become versed in the advantages and disadvantages, results, and outcomes of IGTA for lung malignancies, as well as competing and complementary treatments and therapies.

TIP 4

Firmly understand the ablation energies and technologies and their relative strengths and limitations specific to the device(s) utilized. Ablate wisely to optimize local control while resisting the temptation to aggressively overablate.

TIP 5

Appreciate the potential heat or cold sinks affecting the ablation site and local tumor control and safe strategies to mitigate their influence.

TIP 6

When possible, utilize techniques to avoid collateral damage of normal adjacent structures, specifically the intrathoracic and intercostal nerves, esophagus, trachea, and skin. Techniques include insufflation of air or CO_2; instillation or injection of 5% dextrose in water, normal saline, or short- or long-acting local anesthetic; and mechanical manipulation (lever, push, pull) of target tumors to simply produce a more favorable location for ablation and provide protective offset.[1] Be very familiar with regional nerve anatomy.[2] Nerves of particular interest in thoracic ablation include the phrenic, vagus, recurrent laryngeal, brachial plexus, and sympathetic nerves.

TIP 7

Develop familiarity with the complication profile associated with lung ablation to prevent and effectively manage complications. Develop effective pneumothorax management skills; become extremely comfortable with the management of pneumothorax during and after thermal ablation and bronchopleural fistulas. Appreciate the differences in recognizing and managing hemorrhagic complications related to lung ablation, specifically hemoptysis, hemothorax, and extrapleural hematoma.

TIP 8

Develop and practice comprehensive and diligent patient follow-up. Organize, order, and review relevant imaging. Of particular importance, minimize the potential to lose track of patients after ablation. Collaborate and communicate with referring physicians and diagnostic radiology colleagues on the imaging follow-up protocol and assessment.

TIP 9

Understand the expected and unexpected appearances of the ablation site(s) on intraprocedural imaging and follow-up chest CT and PET/CT.[3] Confirm the ablation margins with liberal use of coronal and sagittal reformations. Consider repeat biopsy and/or ablation for suspected tumor progression or incomplete ablation.

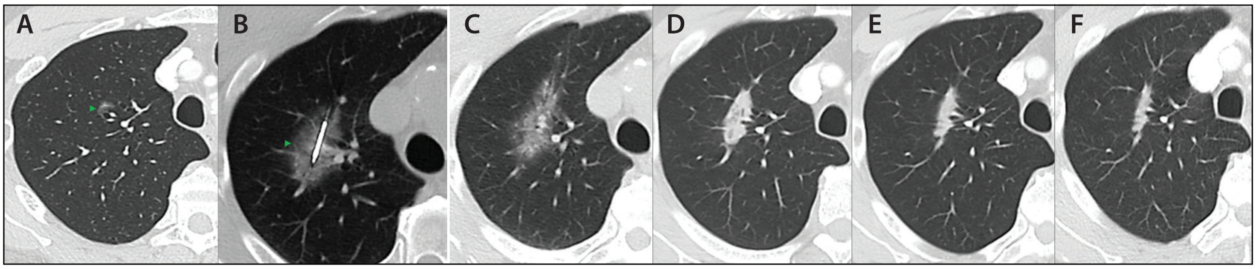


Figure 1. A 73-year-old man with biopsy-proven non–small cell lung nonmucinous adenocarcinoma in situ. Part-solid nodule (arrowhead) resides within the right upper lobe, initially discovered on lung cancer screening chest CT (A). Intraprocedural image showing a single microwave antenna that is well placed within the targeted nodule with ground-glass attenuation (arrowhead) encompassing the entire carcinoma (B). Immediate postprocedural image showing ground-glass attenuation associated with ablation, clearly encompassing the target nodule with adequate coverage margins (C). One-month postprocedural showing that the ground-glass associated with initial ablation has resolved with a well-marginated ablation zone replacing the previous part-solid nodule (D). At 6 months, the ablation zone continues to notably involute in all dimensions (E). At 12 months, further involution of the expected ablation zone has occurred, consistent with successful local control (F).

Incorporate a 1-month follow-up chest CT to establish a baseline postablation, from which time the ablation zone should gradually involute and stabilize (Figure 1).

TIP 10

Assemble a dedicated program for lung ablation, including knowledgeable and skillful operating interventional radiologist(s), nurses, technologists, anesthesiologists, and support staff.

1. Solomon SB, Thornton RH, Dupuy DE, Downey RJ. Protection of the mediastinum and chest wall with an artificial pneumothorax during lung ablations. J Vasc Interv Radiol. 2008;19:610-615.
2. Palussiere J, Canella M, Cornelis F, et al. Retrospective review of thoracic neural damage during lung ablation—what the interventional radiologist needs to know about neural thoracic anatomy. Cardiovasc Intervent Radiol. 2013;36:1602-1613.
3. Abtin FG, Eradat J, Gutierrez AJ, et al. Radiofrequency ablation of lung tumors: imaging features of the postablation zone. Radiographics. 2012;32:947-969.

Robert Suh, MD
Clinical Professor, Radiological Sciences
Vice Chair, Radiology Education
David Geffen School of Medicine at UCLA
Director, Thoracic Interventional Services
Ronald Reagan UCLA Medical Center
Los Angeles, California
rsuh@mednet.ucla.edu
Disclosures: Speaking and teaching for Neuwave Medical, BTG, and Boehringer Ingelheim; consultant to Ethicon.

Pelvic Bone Metastases

BY PAUL I. MALLINSON, MBChB, FRCR, FRCPC, AND PETER L. MUNK, MDCM, FRCPC, FSIR, FFRRCSI (Hon)

Recently, growing interest has been shown in musculoskeletal interventional procedures, specifically thermal ablation and cementation, with increasing experience in treating metastatic pelvic osseous lesions. Diffuse metastatic bone disease is challenging, especially if conventional therapies (radiotherapy, chemotherapy, surgery) are unsuccessful. Large, extensive metastatic deposits in the bony pelvis can appear intimidating; however, percutaneous techniques may markedly improve quality of life without treating the whole lesion(s).

TIP 1

Before planning the procedure, a clear understanding of the patient's symptoms is required. Is the pain mainly on weight bearing or during a particular movement or position? Pinpoint the anatomic location. In patients with multiple lesions, target the site of worst pain to increase the probability of successful pain control and reduce complications. Additional areas can be treated in separate sessions if they become symptomatic.

TIP 2

Pain on weight bearing often requires structural reinforcement of the bone (Figures 1 and 2). Common sites

Figure 1. A coronal cone-beam CT image of the right hip of a 63-year-old man after cementoplasty of a lytic right acetabular renal cell carcinoma metastasis. The cement has been focused at the weight-bearing portion of the joint.

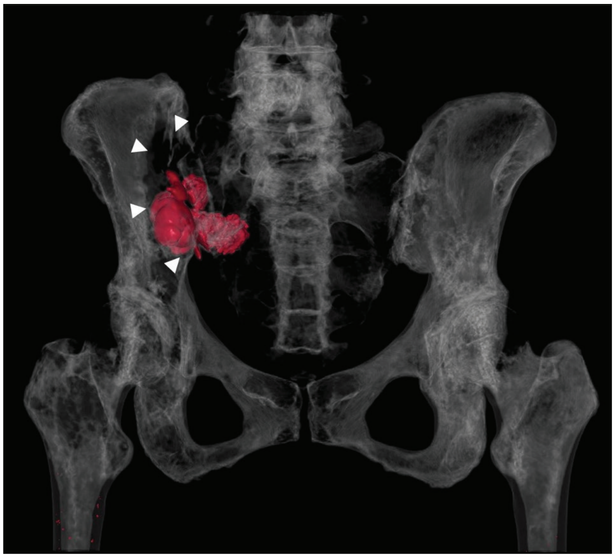


Figure 2. A three-dimensional reconstruction image of the pelvis of a 50-year-old woman with metastatic ovarian cancer after cementoplasty (red area) of the right iliac bone to repair a large lytic defect (arrowheads).

include the supra-acetabular region and superior pubic ramus. Injection of small quantities of methyl methacrylate cement is often sufficient to produce dramatic improvement in pain (Figure 1). Do not cement areas where transmission of weight and force will not be improved (eg, the iliac crest), benefit is unlikely, and the risk of complications related to leakage and mass effect increases. Use thermoablation alone for painful lesions in these locations.

TIP 3

Large soft tissue masses arising from bone metastases may compress a nerve, bladder, or other structure. Thermoablation debulking can lead to improvement in symptoms but can be inflammatory, so the patient must be forewarned of the potential for a short period of symptom exacerbation preceding improvement.

TIP 4

Metastatic disease may require use of both thermoablation and cementation in combination (Figure 3). The destruction of tumor by thermoablation may be further augmented by the limited local cytotoxic effect of methyl methacrylate. The primary function of cement is mechanical reinforcement; however, do not deploy cement for tumor destruction alone.

TIP 5

Thermal ablation of bony lesions prior to cement injection may also improve local cement distribution.

TIP 6

Masses that do not impinge on or lyse surrounding structures or those in non–weight-/stress-bearing bone may not benefit from treatment. Careful examination of the patient and focal symptomatic correlation is essential in these cases.

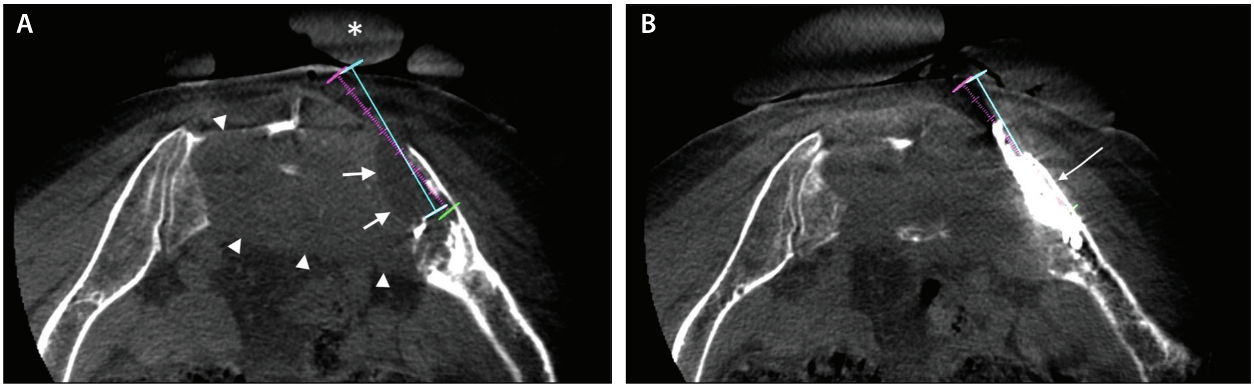


Figure 3. Axial cone-beam CT image of the pelvis of a 57-year-old woman with metastatic lung cancer largely replacing the sacrum (arrow heads) (A). An ice ball has been generated (arrows) using an IceRod cryoprobe (Boston Scientific Corporation) targeted at the bone-tumor interface. The medial lesion has not been treated due to localization of the patient's pain laterally and risk to the sacral nerves. A sterile glove containing warm sterile saline at the skin's surface reduces the risk of thermal injury (*). An axial cone-beam CT image of the same patient after cementoplasty (arrow) to repair the weight-bearing portion of the sacroiliac joint (B).

TIP 7

Our experience has shown that treatment of as little as 10% to 20% of the metastatic disease can produce significant improvement without putting the patient at unnecessary risk. Targeting weight-bearing areas and bone-tumor interfaces is a priority (Figure 3).

TIP 8

The temptation to treat all metastatic bone disease should be resisted; the more extensive the procedure, the higher the risk of complications. Injection of large quantities of cement can produce complications through intravascular venous embolization, joint intravasation, or local neurovascular compression. Less is more.

TIP 9

Understanding patients' particular priorities, goals, and lifestyle will help you guide them through the important decision-making and consent process with an understanding of the risks and rewards pertinent to their case.

Paul I. Mallinson, MBChB, FRCR, FRCPC
Consultant Radiologist
Vancouver General Hospital
Vancouver, British Columbia, Canada
Disclosures: None.

Peter L. Munk, MDCM, FRCPC, FSIR, FFRRCSI (Hon)
Professor of Radiology, Orthopedics and Palliative Care
University of British Columbia
Skeletal Imaging Section Head
Vancouver General Hospital
Vancouver, British Columbia, Canada
peter.munk@vch.ca
Disclosures: Consultant to Merit Therapeutics.

Palliative Care

BY MIYUKI SONE, MD, AND YASUAKI ARAI, MD, FSIR, FCIRSE

Palliative care aims to provide the maximum possible comfort to patients with cancer suffering various symptoms. Although it largely depends on the drug treatments, the use of nonpharmacologic treatments, including interventional radiology (IR) techniques, has been increasing. Interventional radiologists have expertise in offering minimally invasive treatment options for symptom relief based on imaging findings relevant to the causes of the patient's symptoms. This article provides tips related to some of the must-know procedures and the usage of IR in the palliative care setting.

TIP 1

Clinical "refractory pain" may be reduced through IR techniques. For malignant bone tumors, percutaneous osteoplasty is effective for the instability of weight-bearing bones.[1] Arterial embolization and ablative treatments are also applicable with quick reduction of pain, which cannot be achieved with other treatments. For abdominal pain, neurolytic splanchnic nerve block may be a safe and effective IR procedure[2] utilizing CT-guided 21-gauge needle insertion to the bilateral retrocrural space, followed by injection of 20 mL of ethanol (Figure 1).

TIP 2

Interventional radiologists can offer a tailored approach for symptomatic malignant ascites. Paracentesis is a simple and essential technique but is not the only way to relieve symptoms from ascites. Stent placement may directly resolve the cause of ascites if the patient has stenosis of the portal vein or the hepatic vena cava. The Denver peritoneovenous shunt (BD) may

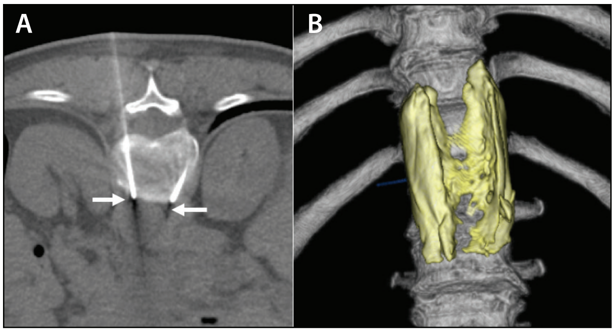


Figure 1. CT-guided splanchnic nerve neurolysis. Needles are inserted in the bilateral retrocrural space (arrows) (A). Three-dimensional CT with contrast injection confirming the distribution of the neurolytic drug (B).

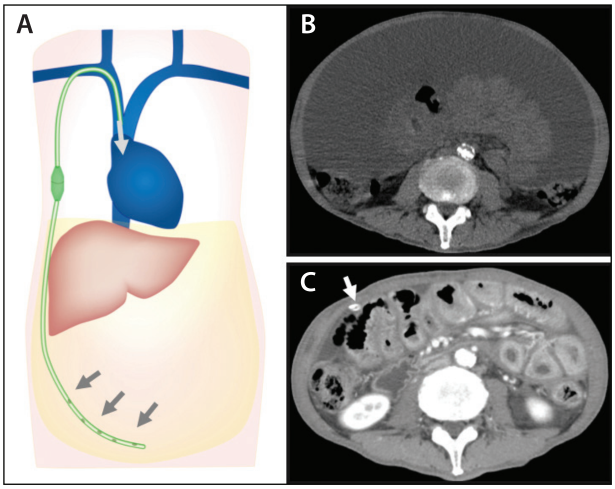


Figure 2. A subcutaneous Denver shunt tube recirculates ascites from the peritoneal cavity to the superior vena cava through a chamber (A). Massive malignant ascites in a patient with pancreatic cancer (B). The Denver shunt (arrow) remained effective at 5 months after placement (C).

applicable in various situations including ascites containing malignant cells (Figure 2).[3]

TIP 3

Vena cava stenting is an evidence-based technique that may be used to improve quality of life. Efficacy of stenting for vena cava syndrome has been reported since the 1980s; however, considering the associated risks for patients with acutely deteriorated physical status, more evidence regarding its effectiveness was required. Results of a randomized controlled trial following a phase 2 trial were recently reported by Takeuchi et al and demonstrated significant improvement of symptoms caused by vena cava syndrome in the stent group compared with the control group.[4]

TIP 4

Percutaneous transesophageal gastrotubing (PTEG) is a need-to-know IR technique. For patients with bowel obstruction with previous gastrectomy or a contraindication to venting gastrostomy, PTEG is effective and provides high patient satisfaction.[5] A needle is inserted to the cervical esophagus under ultrasound guidance using a slow-leak balloon, and an indwelling catheter is placed (Figure 3). This technique allows the patient to forego a nasogastric tube and function with dignity.

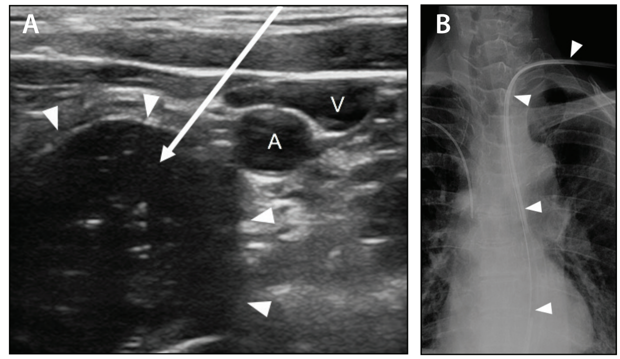


Figure 3. The PTEG technique. An ultrasound demonstrates the esophagus dilated with a slow-leak balloon catheter (arrowheads) (A). The carotid artery (A) and internal jugular vein (V) are displaced by the balloon. The arrow indicates the puncture route. A catheter is placed from the cervical esophagus to the stomach (arrowheads) (B).

TIP 5

Collaborative efforts with percutaneous endoscopic hybrid approaches to complex biliary obstructions warrant consideration. Endoscopy has become mainstream in biliary drainage, and emerging techniques of endoscopic ultrasound-guided transmural biliary drainage have expanded the indications. However, effective drainage for patients with multiple biliary stenoses or previous biliary reconstruction surgery remain challenging. We started collaborating with endoscopic experts in our IR suites for challenging cases (Figure 4).

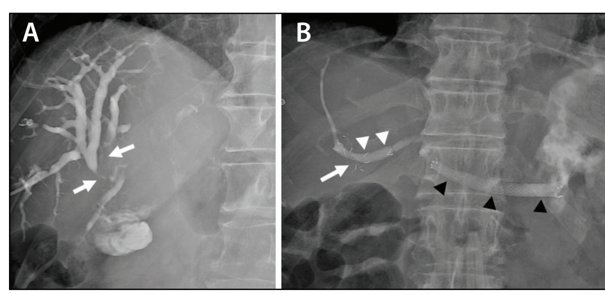


Figure 4. Percutaneous endoscopic hybrid treatment for multiple hilar biliary stenoses in a patient with recurrent bile duct cancer. Percutaneous cholangiography from the right anterior biliary branch demonstrates multiple stenoses at the hilum (arrows) (A). The left biliary trees are not seen. Two drainage routes were established to maintain stable biliary drainage. First, the right anterior branch was bridged with the left lateral segmental branch by percutaneous stenting (white arrowheads) (B). The endoscopic ultrasound-guided hepatogastrostomy stent (black arrowheads) is opacified from the percutaneous stent. This route goes to the jejunum through the gastrojejunostomy, avoiding the recurrent tumor. Second, a stent was placed percutaneously from the right posterior branch to the jejunum (arrow).

TIP 6

For the extraordinarily tough cases, think in a flexible way so as to fully exploit all of the IR techniques. Sometimes, there seems to be no solution for patients with advanced disease; however, that is the time to mobilize all knowledge and expertise. Onishi et al reported a patient with massive urine leakage from a vesicocutaneous fistula after multiple surgeries for rectal cancer.[6] The patient underwent embolization of the fistula and bilateral nephrostomy subsequently combined into a single left-to-right catheter as urinary diversion.

TIP 7

Underreferral is a main obstacle for palliative IR. At present, IR is not sufficiently visible in the palliative care community. We should improve awareness of IR through communication with palliative care specialists on how IR may fit into the palliative care spectrum and better outline the advantages and drawbacks of each IR procedure. ■

1. Kobayashi T, Arai Y, Takeuchi Y, et al. Phase I/II clinical study of percutaneous vertebroplasty (PVP) as palliation for painful malignant vertebral compression fractures (PMVCF): JIVROSG-0202. Ann Oncol. 2009;20:1943-1947.
2. Kambadakone A, Thabet A, Gervais DA, et al. CT-guided celiac plexus neurolysis: a review of anatomy, indications, technique, and tips for successful treatment. Radiographics. 2011;31:1599-1621.
3. Sugawara S, Sone M, Arai Y, et al. Radiological insertion of Denver peritoneovenous shunts for malignant refractory ascites: a retrospective multicenter study (JIVROSG-0809). Cardiovasc Intervent Radiol. 2011;34:980-988.
4. Takeuchi Y, Arai Y, Sone M, et al. Evaluation of stent placement for vena cava syndrome: phase II trial and phase III randomized controlled trial. Support Care Cancer. 2019;27:1081-1088.
5. Aramaki T, Arai Y, Inaba Y, et al. Phase II study of percutaneous transesophageal gastrotubing for patients with malignant gastrointestinal obstruction; JIVROSG-0205. J Vasc Interv Radiol. 2013;24:1011-1017.
6. Onishi Y, Arai Y, Sone M, et al. A novel technique of urine drainage from bilateral kidneys with a single catheter. J Vasc Interv Radiol. 2019;30:412-413.

Miyuki Sone, MD
Consultant, Department of Diagnostic Radiology
Head, Interventional Radiology Center
National Cancer Center Hospital
Tokyo, Japan
msone@me.com
Disclosures: Research funding, Canon Medical Systems.

Yasuaki Arai, MD, FSIR, FCIRSE
Executive Advisor to President
National Cancer Center
Department of Diagnostic Radiology/Interventional Radiology Center
National Cancer Center Hospital
Tokyo, Japan
Disclosures: Research funding, Canon Medical Systems.